SPEAR 4kHz Timestamp System

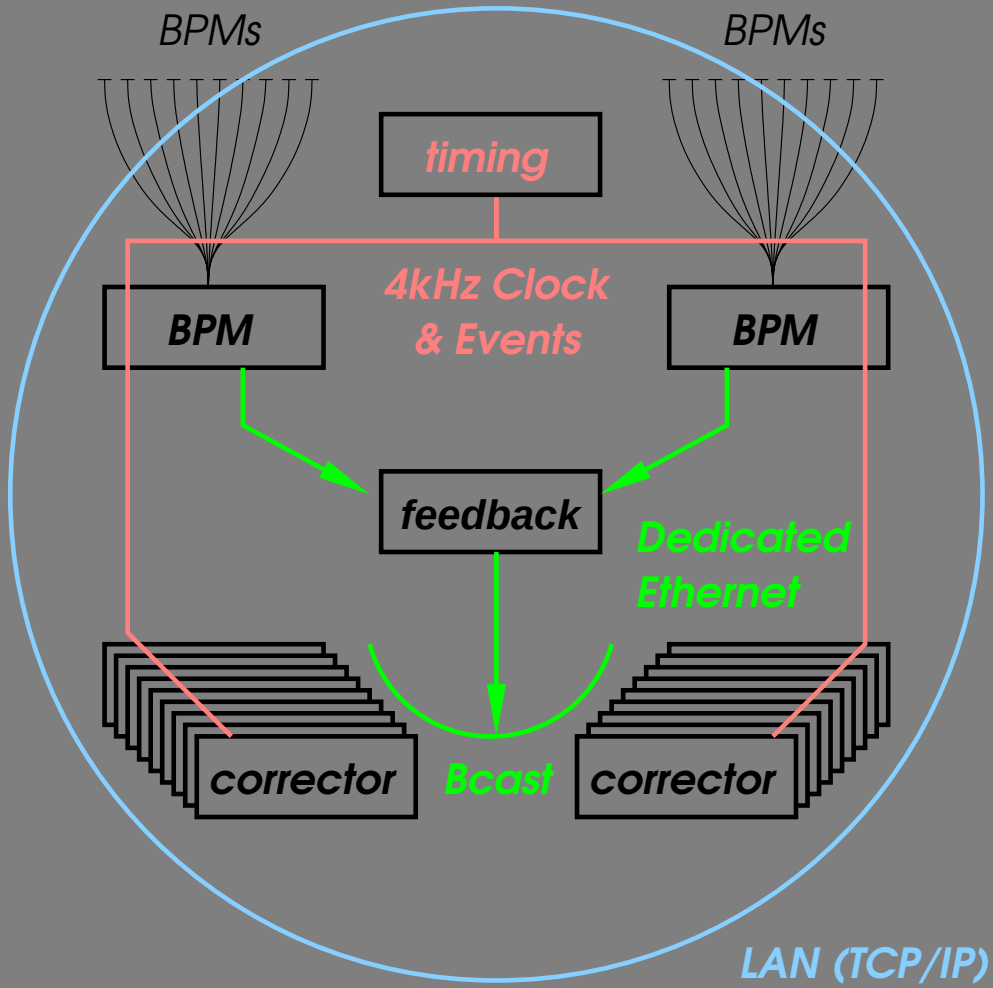
Till Straumann
SSRL/SLAC

Overview

- BPM and Orbit Feedback System
- Analog BPM Processing
- Timing Requirements
- Timestamp Protocol
- Application Example
- Q ’n A

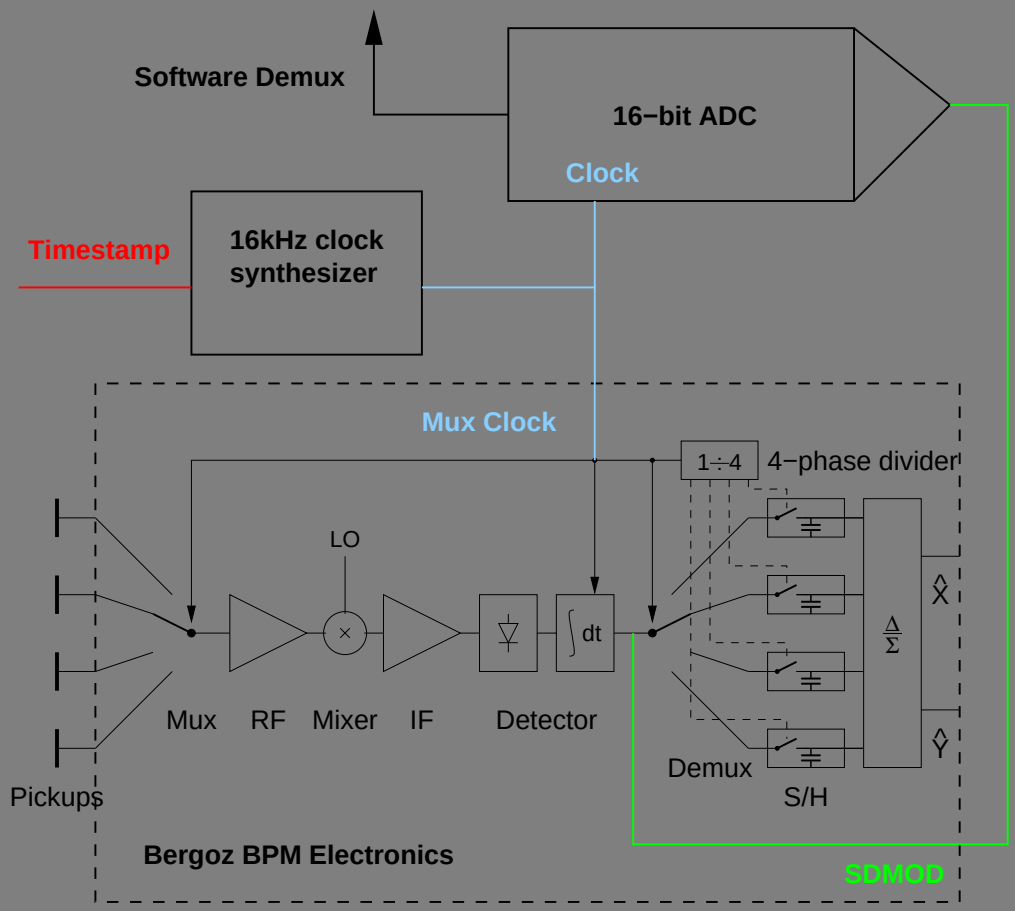
SPEAR Orbit Feedback

- Hybrid BPM System
  - Conventional "Bergoz" electronics
  - Digital Receivers (Echotek)
- Synchronous data acquisition clock Frev/320 ~4kHz
- Global synchronization



Analog BPM Data Acquisition

- Not using analog X/Y outputs
- Instead, digitize multiplexed baseband signal and demultiplex in software; calculate difference/sum
  - no offset errors due to analog circuit
  - no dependency on offset or gain of ADC
  - half the number of ADC channels needed
- ADC: 64 parallel 16bit ADCs with FIFO, autocalibration and DMA engine on a PMC module (PMC16AI64SS by General Standards; EPICS drivers available)
- However: synchronous clock needed to drive Bergoz mux
- Use timestamp as HW clock -> data stream in-sync with other BPM IOCs -> synchronous 4kHz orbits

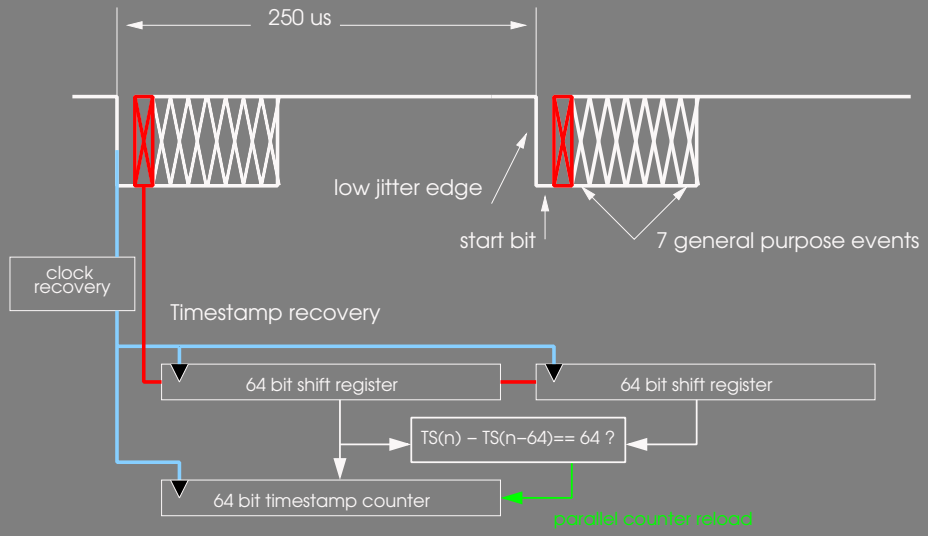


Timing Requirements

- Clock signal at subharmonic of Frev (low kHz range)
- Distribution to multiple remote locations (devices, IOCs)
- Synchronization features:
  - distribute ’global timestamps’
  - distribute ’global events’ (for triggering)
- Timestamp: 64-bit counter, incremented at every 4kHz clock cycle; counter value to be distributed
- Easy conditioning of a relatively low-jitter (<1us) clock

Timestamp Protocol

- Serial, 8bit data word at 115kBd every 250us (1/4kHz)
- Low jitter leading edge of start bit
- Use 7 bits as ’event flags’
- Serial transmission of a 64-bit timestamp in the 8th bit
  - -> full timestamp is transmitted in 64 cycles
  - -> receiver has to maintain its own TS counter; use simple synchronization algorithm
- Easy clock recovery by (digital or analog) "retriggerable one-shot"
- Use simple UART as a receiver.



EPICS Support

- What to do? Setup over channel access (Timo)
- When to do? Triggered by event/timestamp
- Some device support modules use TSE==epicsTimeEventDeviceTime
  - Set nanosecond part of TIME to SPEAR timestamp (e.g., from real-time processing task).
  - "Seconds"-part still ship wallclock time -> both worlds
- -> PVs on different IOCs can be precisely aligned in time.

Application Example: Orbit Interlock Trip Diagnostics

- Fast orbit interlock trips in less ~1ms if the beam leaves safe operating area
- Ring buffers in various IOCs log diagnostic info
- Interlock trip raises event -> freeze buffers
- Pre-mortem history can be re-assembled from different PVs using timestamps